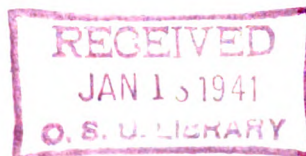


UNITED STATES
DEPARTMENT OF THE INTERIOR
HAROLD L. ICKES, SECRETARY

BUREAU OF MINES
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INFORMATION CIRCULAR

HOW MINE WORKERS CAN HELP TO PREVENT
MINE EXPLOSIONS



BY

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INFORMATION CIRCULAR

UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

HOW MINE WORKERS CAN HELP TO PREVENT
MINE EXPLOSIONS^{1/}

By D. Harrington^{2/}

Coal-mine explosions are accidents that can and should be prevented. In former years hundreds of lives were lost each year in the United States as a result of such explosions, but after 1932 the numerous precautionary measures adopted had reduced their frequency and severity 75 percent or more until in 1940 several very disastrous explosions marred the good record. Unfortunately, both the number and severity of explosions seem to be tending to increase compared with the relatively good achievement from 1933 to 1940. The requisites for an explosion are ever present in all soft-coal and many hard-coal mines. A certain combination of circumstances, such as a flame or an arc in a cloud of dust or in a body of gas or both may start an explosion at any time. The fact that the frequency and severity of explosions were lowered for 6 or 7 years is no guarantee that such freedom from explosions will continue, as the bad record of 1940 has shown, and underground workers should feel honor bound to exercise the utmost care so that they will not help to bring about the circumstances that will cause an explosion.

Although mine operators bear the main responsibility for preventing explosions, miners can do many things to help. As about 9 out of 10 explosions begin at a working face, it is largely within the power of workers to prevent them. All miners should do their part willingly and should not defend a fellow workman from punishment, even from discharge, for disobeying necessary rules, whose disregard may cause the death not only of the safety-rule breaker but also of many of his coworkers.

When a miner is careless and is injured some other way than by an explosion he may be the only one to suffer, but if his carelessness causes an explosion he not only endangers his own life but also that of every other man in the mine and possibly the lives of persons outside the mine.

Experiments have shown that ignition of as small a quantity as 150 cubic feet of an explosive mixture of methane and air under certain circumstances can start an explosion that will traverse an entire mine. Thus, ignition of

1/ The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from Bureau of Mines Information Circular 7138."

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an explosive mixture of gas 1 foot down from the roof and 13 feet back from the face of a 12-foot entry might cause a widespread explosion if the right quantity and kind of dust were present. Many persons have ignited much larger quantities of gas without being killed, but they survived only because dust, confinement, and other conditions were not exactly "right."

Few people realize that coal-mine disasters seldom occur in very gassy mines; by far the greatest number have been in mines that contain little gas and are called "nongassy." Mines known to be very gassy usually are effectively ventilated and otherwise safeguarded. A so-called "nongassy" mine that has a little gas is by far the most hazardous type.

Fine, soft coal dust in suspension is but little less dangerous than a similar quantity of fine black powder in the air, and not much coal dust is required to start an explosion or keep one going. The quantity of dust that can be stacked on a 50-cent piece is the minimum that, in suspension per cubic foot of air, will keep an explosion going; this amounts to 5 or 6 ounces of fine coal dust per linear foot in an ordinary 6- by 10-foot entry. Evidently no bituminous-coal mine, except possibly one every part of which is thoroughly wet, can be so free of dust that a coal-dust explosion is impossible. Wet coal dust will not ignite to cause an explosion and is difficult to throw into the air; but if an explosion gets a good start by a gas ignition or other means and damp to wet coal dust is thrown into the air it is possible, even probable, that the dust will extend or propagate the explosion. Nevertheless watering is very helpful in preventing dust from getting into the air.

Mine officials and operators are responsible for providing adequate ventilation and methods of rendering the coal dust nonexplosive and for reducing to a minimum the conditions that might start an explosion. Miners cannot control the general ventilation of a mine so that it will conform with State laws. Such control is the responsibility of mine officials under the supervision of State mine inspectors. However, miners can and should call the attention of fire bosses, foremen, or State inspectors to any serious lack of fresh air in the working place or any interruption in the circulating system. Certainly miners should not do anything that would prevent ventilation from being effective.

All mine employees should be on the lookout for dangerous conditions and, when they find them, should ask the mine officials to remedy them. Each miner should close promptly all ventilating doors he has opened in traveling to and from his working place; if he finds a door propped open that has no written notice instructing that it be left open, he should find out why it is open by inquiring from the nearest mine official before he enters the district or working place in which the ventilating current has been short-circuited by opening of the door. Too often a door that directs the air current into a branch entry is propped open by a careless driver or motor-man who intends to return soon with a trip of cars. If the driver or motor-man is delayed the door may be left open for a dangerously long time, thus short-circuiting the air and perhaps permitting dangerous quantities of gas

to accumulate. Several serious mine explosions have been caused by this practice in the past few years. Doors that are supposed to remain closed should not be propped open; and no door should have a latch to hold it open unless the door is to remain open virtually all the time.

Miners should notice from time to time whether the usual amount of air is entering their working places and, if not, should investigate to see whether a door has been left open, a curtain torn down, or a brattice broken by a fall.

In gassy mines that require line brattices to the face miners should see that these are tight. Frequently a small fall of rock may tear down part of the brattice or leave an opening above it that will short-circuit the air current. Even though not required to do so by the terms of their employment, miners should make temporary repairs to working places for their own safety as well as that of fellow workers.

About one-third of the coal-mine explosions have been caused by open lights, and most of them have been in so-called "nongassy" mines. The fact that any bituminous-coal mine is likely to become gassy suddenly and unexpectedly makes the use of permissible electric cap lamps imperative if maximum safety is to be obtained. Miners should welcome the substitution of up-to-date, safe, and efficient permissible electric cap lamps for the out-of-date, inefficient, and dangerous open lights so often found in mines, even though they may think that the electric lamps are not as convenient as open lamps; the superior lighting efficiency of the cap lamps and the fact that they are much less likely to start a fire or an explosion far outweigh any handicaps that they may have.

Mining laws and company rules often prohibit the carrying of matches and smoking materials into gassy mines; however, experience has shown that these regulations are violated by many miners as well as by some mine officials, and numerous explosions have resulted when underground workers have attempted to smoke. Any person who willfully carries matches and smoking material into a gassy mine endangers not only himself but also every man in the mine and should be severely punished as he is potentially a murderer of his fellow workers. Anyone who works in a mine should think enough of his own safety to report violations of the "no-smoking" rule.

Numerous explosions have been caused by direct violation of mining laws or mine rules, and men have willfully passed over danger boards into abandoned or idle workings and caused explosions. Danger boards are placed at or across openings as a warning of some hazardous condition beyond; under no circumstances should men go beyond these warning notices.

Most experienced miners know that the flame of a black-powder shot will ignite gas or coal dust. In past years black powder and dynamite have frequently caused explosions; moreover, innumerable fires have been started by shots of black powder or dynamite. Some miners believe mistakenly that black powder in pellet or stick form is a safe explosive; the only difference is that an open flame is slightly less likely to ignite pellet powder than

granular powder. Permissible explosives have a flame of short length and duration, and no explosion is known to have occurred with such explosives when they were used in a permissible manner; however, even permissible explosives must be used carefully, as all explosives are inherently dangerous.

In many mines the miners prepare and fire their own shots and therefore are responsible for the safe use and handling of the explosives. Miners can contribute not only to their own safety but also to that of their coworkers by observing the following precautions: (1) No hole should be shot "on the solid"; (2) no more than 1 1/2 pounds of permissible explosives should be used to the hole; (3) clay, sand, or rock dust, not fine coal, should be used for stemming, and the hole should be tamped to the mouth; and (4) shots should not be fired in the presence of gas. Where shot firing is done by special shot firers after the miners have left the mine no shot that a worker would be unwilling to fire himself should be prepared for the shot firer.

The wider use of electricity in coal mines during recent years has increased the hazard of ignition of gas and dust owing to arcing and sparking of electrical devices and equipment. Electric arcs in mines come from non-permissible mining machines, locomotives, and other electrical equipment and from faulty wiring, trolley wire, and signal wires. Permissible electrical equipment is available which, if kept in permissible condition, will not ignite gas or dust, and it is the duty of mining companies to provide permissible equipment and of those who handle the equipment to maintain it so.

More men lose their lives from suffocation by gases caused by explosions than are killed by burns or the violence of explosions, and many deaths from suffocation could have been avoided if the miners had given some thought beforehand as to what they might do to save themselves if they survived in a mine after an explosion.

The natural impulse when a worker survives an explosion is to escape as quickly as possible, and undoubtedly this is normally the best thing to do; nevertheless it may sometimes be safer to stay in the working place or in some other suitable and accessible location. Quick decision is necessary, and all who work in coal mines should do a little thinking and planning beforehand as to the best procedure if they should survive an explosion. Each underground worker should know the system of ventilation in his section of the mine and the course of the "intake" and "return" air so that he may recognize the meaning of the movements of air after an explosion. If the air is moving the best way to proceed generally is toward the incoming fresh air. If the explosion has passed outby the section of the mine in which a man is working, even at best some gases from the explosion probably will be present in the intake. If smoke and gas are considerable and a worker is far in the interior of the mine, he should not try to go out through the bad air as he is very likely to be overcome. On the other hand, the incoming air to the section in which a man works may be the return air current from the section in which the explosion occurred, in which case, if the air is not already

gassy or smoky, it may be advisable to go with the current, if there is any, and try to keep ahead of the smoke and gas. If the air is very bad because of smokiness, heat, or other reasons, the workers should not try to penetrate it but should retreat toward the face, propping open any doors that may short-circuit the smoke and gases, and should erect stoppings or brattices from any available material. Of course all openings to the barricade should be sealed or closed as effectively as possible. It is impossible to state where stoppings should be placed, as conditions vary in different mines, but generally the larger the area containing fresh air that can be enclosed the better, as the greater the volume of air the longer it will sustain life.

Each mine worker should be on the lookout constantly for dangerous conditions in and around the mine, and when he notices an unsafe condition, even if it is caused by the action of a fellow worker, he should try to correct it immediately or report it promptly to the mine foreman or safety inspector. All underground workers should "keep an eye" on new men coming into the mine to see that they do not jeopardize their own lives or those of their fellow workers; the carelessness of some person or persons (workers or officials) is the real cause of most accidents, particularly most mine explosions.

Rock dusting undoubtedly has saved hundreds of lives in coal mines of this country during the past decade, yet relatively few of the coal mines of the United States are, or ever have been, even reasonably well rock-dusted. Mine workers usually feel that rock dusting is purely a duty of operators, yet undoubtedly workers should be far more interested in this safety measure than operators because it is their lives that are at stake. Workers should take an active interest in rock dusting to the end that every bituminous and lignitic coal mine (gassy or so-called "nongassy") may be well rock-dusted at all times and should contribute their share of the watering, rock dusting, or other dust-prevention measures that are taken in the mine where they work. The coal mines of the United States probably will never be rock-dusted adequately until all workers show far more interest in this phase of coal-mine accident prevention than they have to date.

Explosions will not occur in coal mines if care is taken and common-sense practices are kept in effect. Explosion and fire disasters are not acts of God. They are due to sins of omission or commission by men, who have almost the entire responsibility for preventing these dread disasters in mines. When a disaster occurs carelessness is invariably responsible.